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Talking Stars And Talking Cars
Satellites and cellular phones have developed along separate paths. But it is possible the 90s will see an evolution toward the integration of these two technologies.

Satellites and cellular phones are two of the hottest technologies for the 1990's. Is there any opportunity for these two telecommunications systems to integrate? Is there a multi-technology synergy involving satellite and cellular waiting to be discovered?

Satellites in the 90's

Most satellite systems in the 1990's will concentrate on television distribution and defense communications. A tabulation of those satellite systems which might be partners for cellular compatibility is provided in Figure 1.

Television distribution satellites include most prominently the Hughes domestic satellite system, the new direct broadcast satellites (DBS) in Europe and Japan, and the Intelsat global system. Defense communications will continue to be provided via expensive satellite systems such as Milstar in the United States and Skynet in Europe.

A unique satellite system called GPS Navstar will be operated by the Defense Department, but used mostly by civilians for mobile position determination. This satellite system includes 24 satellites in various 10,000 mile orbits over the world, at a cost to U.S. taxpayers of more than \$5 billion. However, it will provide highly accurate position fixes--better than 100 meters--to marine, air and land mobile users worldwide, at no charge.

Newly evolving satellite services include networking small, customer site earth stations (VSATs), and mobile communications. The largest provider of mobile satellite services is the Inmarsat system, with more than 10,000 users worldwide. However, Geostar and Qualcomm in the United States are rapidly gaining new customers for their truck tracking services.

Geostar, a quasi-public company, reported in 1989 that more than 11 million shares were outstanding at a most recent share price of \$14 per share. This impressive valuation is further burnished by its reports of having provided more than 20 million commercial position fixes. Qualcomm, a private company, reports that it has more than 8,000 trucks equipped with its Ku-band vehicle tracking system. Qualcomm's strength's were evident in its recently successful \$30 million private placement financing.

Cellular in the 90's

Further out on the horizon are concepts for a geostationary land mobile satellite service by the American Mobile Satellite Consortium (AMSC) and a competing concept that uses low earth orbit satellites called OrbComm. The latter concept, envisioned by launch pioneer Orbital Sciences Corp., would incorporate 20 satellites in 1,000 km orbits to provide vehicle tracking and two-way data messaging services worldwide. These services will be provided at VHF region frequencies and have been dubbed

Securnet, Datanet, Mapnet and Vitalnet.

Finally, concepts are being defined for a satellite sound broadcasting service that would transmit compact disc quality radio programming directly to cars from space. No companies have yet announced specific plans, but the general idea is receiving aggressive backing from the European Broadcasting Union (EBU).

Which, if any, of these various satellite systems likely to be in use during the 1990's will be compatible with cellular telephones? Before addressing that question, let's examine the likely cellular telephone situation in the new decade.

Cellular telephony has garnered nearly 3 million subscribers in the United States to date, and is on a growth track toward 25 million subscribers by the year 2000. All major metropolitan areas enjoy cellular service. Licenses to construct cellular systems in rural areas have recently been issued. Nearly 100 percent of the U.S. population is expected to be covered by cellular telephone service within the next five years. The European situation is similar, although subscriber ramp-up rates are somewhat behind those in the United States.

The cellular telephone network soon will be enhanced with a variety of new technologies. A parallel digital cellular telephone network will enhance system capability high enough to handle the 25 million subscribers expected by the end of the decade. This network will be built by current cellular system operators. Meanwhile, a cellular-type concept called Personal Communications Network (PCN) is being deployed in Europe to further expand the reach of personal communications. There is some technical debate as to whether these new digitally-based cellular systems should use time division or code division sharing techniques.

The PCN is a cellular-type technology because urban coverage is provided with many low power repeaters, each covering a cell, or small part of a city. PCN differs from standard cellular phone service in that the cell sizes are much smaller and the technical standards are quite different. Nevertheless, a PCN phone can call a cellular car phone since both systems are interconnected via the public switched telephone network.

PCN phones are expected to be much smaller and less expensive than cellular car phones. Regulatory authorities appear to be inclined to award PCN licenses to companies other than the local cellular operator. The competition is likely to result in lower mobile telephone charges. Although PCN is most advanced in Europe, the FCC has awarded an experimental PCN license for the United States.

A comparative timetable of cellular communications and mobile satellite development is provided in Figure 2.

Compatibility Options

Five plausible possibilities for satellite-cellular compatibility include wide-area mobile telephone service, cellular auxiliary service, automatic vehicle location (AVL) service, pay-per-listen digital satellite radio and satellite-cellular CB service.

Wide area mobile telephone service is a market concept that extends both within and outside cellular telephone coverage areas. The basic idea is that some people want their car phone to work via cellular -- when available -- and via satellite, when the roam light goes off, (See Figure 3).

Initially, the AMSC planned on a large market for such hybrid "satellite phones." However, as rural cellular began to unfold, AMSC has backed away from this market. The European telephone operating companies, acting through the European Conference of Posts and Telecom (CEPT), concluded that such a hybrid satellite-phone market is too small to be viable. Today, most experts believe that the vehicle that must always stay in touch will be equipped with both a cellular phone and a separate satellite phone.

Cellular Auxiliary Service

A cellular auxiliary service was recently described by Orbital Communications Corporation (Orbcomm) in its precedent-setting application to the FCC for a 20-satellite constellation. The Orbcomm satellites would be used to provide "call waiting" and "answering machine" capabilities to cellular telephone users whose lines are busy. The basic Orbcomm message handling routine is described in Figure 4.

As explained by Orbcomm, its data-only satellite system could convey a message that someone wants to speak with a person already speaking on a cellular phone. OSC says Orbcomm user terminals will cost less than \$100, and so might reasonably be built into some cellular telephones. For example, a hybrid cellular telephone-Orbcomm user terminal might have a separate LCD display for data messages received via satellite. Hence, during a cellular phone conversation on the highway, a tone might alert the conversant to a data message on his handset. The data message would have been sent via the Orbcomm satellite because the cellular channel was busy.

The biggest problem with satellites serving cellular auxiliary functions is the competition to be provided within the cellular network itself. Most of the new digital cellular concepts, and especially a code division process proposed by Qual-comm, provide for call waiting, call forwarding, automatic caller ID and other ISDN-type services. The digitization of the public switched telephone network has enabled most Americans to enjoy value added services such as call waiting. We can expect more of the same in the mobile world as digital cellular becomes operational during the 1990's.

Satellite-Cellular AVL

Automatic vehicle location is a new market to track the location of vehicles. The reason for AVL is that trial programs in the late 1980's demonstrated clear cost savings when AVL was applied to trucking firms, municipal bus fleets and police departments.

The most likely nexus of satellites and cellular for AVL involves connecting a GPS Navstar radio to a cellular telephone. The GPS Navstar radio outputs a continuous, precise indication of the vehicle's latitude, longitude, velocity and time. This information could then be sent out via the cellular telephone, to a pre-programmed number, with fleet dispatchers monitoring vehicle locations.

GPS Navstar radios have fallen in price from \$30,000 in 1987 to \$2,000 in 1990. Sony press releases promise a \$700 GPS radio very shortly. Since more than 100 companies are manufacturing GPS radios, it would not be surprising to see competitive pressures push prices down low enough for hybrid cellular-GPS Navstar terminals to become economical. GPS chip sets will probably become inexpensive due to volume demand from automobile manufacturers, which are planning for GPS-based vehicle navigation systems.

GPS Accuracy

An unresolved issue for GPS is its accuracy. Originally, GPS was intended for military use. Congress mandated civilian use as a condition for funding. The Department of Defense then conceived a two-tier GPS access structure: 10 meter accuracy for military users; 1 kilometer accuracy for everyone else. Additional lobbying on the part of the surveying industry eroded the DOD's position until consent was given for 100-meter accuracy for civilians. Then, when GPS satellites began to be launched in 1989, it was discovered that civilians could obtain 30 meter accuracy. In essence, the GPS system worked better than DOD's engineers had planned.

Now a debate is raging as to whether DOD should degrade the performance back down to 100 meters, or whether civilians should be entitled to retain the 30-meter accuracy level. Others in the debate are asking for a "peace dividend" of the ultimate 10-meter accuracy for civilians. Very high accuracy is needed for applications such as city street navigation, finding a truck trailer in a truck yard packed with hundreds of them, general aviation piloting, boating in fog and surveying.

AVL Economics

Several studies have shown that severe buyer resistance is encountered if an AVL system costs more than 5 percent of the underlying vehicle cost. Figure 5 plots the addressable market for AVL equipment as a function of AVL hardware cost, assuming that such hardware costs no more than 5 percent of the vehicle cost. For example, approximately 10 million vehicles are produced each year in the \$10,000 price range. At \$500, or 5 percent of \$10,000, AVL hardware would have an addressable market of 10 million vehicles.

Note that current satellite AVL systems, such as Geostar and Qual-comm, are focusing on the 50,000 vehicle-per-year high-end trucking market. This is because the high cost of the big rigs enables their owners to justify the \$4,000 hardware charge. If future cellular-GPS AVL equipment, or Orbcomm-type equipment, can be produced for around \$500, then a broader automobile AVL market can be addressed. It also is worthwhile to remember that digital cellular systems may be able to provide positioning information independent of any satellite link-up. This is because ranging information can be gleaned from the spread spectrum codes used in code division digital cellular.

Pay-Per-Listen Digital Satellite Radio

Another possible point of compatibility between cellular and satellites involves pay-per-listen radio. The gist of this application is to use the car's cellular phone to downlink or descramble specifically requested compact disc quality music. (See Figure 6).

Pay-per-listen has already met with success in the cable TV arena. The first subscription digital radio channel will be inaugurated over cable TV this summer. Pioneered by Jerrold, this system will be the world's first attempt at commercial transmission of compact disc quality music for a fee. Jerrold has reported great success in its market trials, with substantially higher subscription levels than most video channels garner.

Compact disc quality music will probably start being delivered to cars in the mid-1990's. It cannot be delivered over conventional AM or FM bands. Hence, a new digital radio receiver will be required. Most of these CD-quality broadcasts will be received directly from a satellite. Complimentary terrestrial transmission of digital radio also is likely.

A straightforward way to accomplish pay-per-listen CD radio is for the satellite to transmit a menu, or play list, at the same time that it transmits the music. The menu is like an electronic version of old jukebox music cards. By dialing an 800 number or local access number on a cellular phone, punching in your personal identification number and selection numbers, the digital satellite radio operations would immediately descramble your music. A modest satellite jukebox charge would appear on your phone bill.

Sat./Cell. CB Service

One of the most unique concepts for satellite-cellular compatibility is to use a powerful satellite to convert the cellular telephone from a point-to-point to broadcast media (See Figure 7).

Cellular phones, like all telephones, are point-to-point media because generally we can speak with only one person at a time. Conference calls and party lines stretch this definition quite a bit. But even these innovative applications are possible only between a definite number of extensions.

Broadcasting, on the other hand, is defined by the involvement of a large number of generally unknown receivers. Occasionally, the broadcasting and telephone world cross paths. Perhaps the most popular examples are radio and television call-in shows.

A satellite-cellular CB service would be different from anything else in America's ample telecommunications menu. Necessary equipment consists of a satellite-cellular receiver-handset, a satellite sound broadcasting type satellite, and some network control and uplink queuing computers.

From the satellite-cellular handset a person would dial a 900 number

and spill out their heart to the nation. The cellular network would pass the call to network control and uplink queuing computers. From there, the call would be bounced off a sound broadcasting satellite, and be received by satellite-cellular receiver-handsets nationwide. To hear the call it would be necessary to have your receiver-handset tuned to the "Satellite CB" channel. Anyone turned on by the satellite-cellular CB broadcast could then pick up their cellular handset and reply. In a similar fashion, their reply would be heard by the nation.

The satellite-cellular CB concept differs from today's land-based CB in that range is national rather than a few miles of highway. It also differs from radio call-in shows because anyone can answer a call-in, not just the talk show host. Also, by linking cellular and satellite systems in Europe, Japan and the United States via fiber-optic or Intelsat, the satellite-cellular CB network's reach can be extended globally.

Concepts for satellite-cellular compatibility abound. Nevertheless, all of them are concepts for the 1990's; none have been implemented to date. The success of any satellite-cellular system will be dictated by the extent to which they satisfy customer needs, and by the proper sequencing of a business implementation plan.

In the 1990's high technology will start to give way to multi-technology. Separate high technologies will constitute the building blocks of a multi-technology product, much like separate microprocessor chips are combined into consumer devices. In forging a multi-technology product it is essential to weave together separate software, systems and processes. In doing so we must always remember that the fabric is the customer, not the loom. People buy products, not technologies.

PHOTO : Hub station

PHOTO : VSAT terminal

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| Set | Items | Description |
|-----|-------|--|
| S1 | 11374 | ((PAY () PER() VIEW) OR PPV) (S) (AD OR ADVERTISEMENT OR OFFER?) |
| S2 | 5075 | ((PAY () PER() VIEW) OR PPV) (5N) (AD OR ADVERTISEMENT OR OFFER?) |
| S3 | 114 | S2 AND (INTERVAL? OR PERIODICALLY) |
| S4 | 96 | S3 NOT PY>2000 |
| S5 | 83 | RD (unique items) |
| S6 | 278 | ((PAY () PER() VIEW) OR PPV) (5N) (COMMERCIAL?) |
| S7 | 229 | S6 NOT PY>2000 |
| S8 | 187 | RD (unique items) |
| S9 | 134 | S8 AND (SELECT? OR BUY? OR PURCHAS? OR ACCEPT?) |
| S10 | 8 | S9 AND ((COMMERCIAL?) (7N) (PURCHAS? OR SELECT? OR ACCEPT? OR ORDER? OR BUY?)) |
| S11 | 117 | ((PAY () PER) (3N) COMMERCIAL) |
| S12 | 88 | S11 NOT PY>2000 |
| S13 | 67 | RD (unique items) |
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| S15 | 4 | S14 AND (PAY () PER () LISTEN) |
| S16 | 60 | S2 AND (BROADCAST (4N) (AD OR ADVERTISEMENT OR OFFER)) |
| S17 | 55 | S16 NOT PY>2000 |

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Satellite Radio Start-Ups Seek Subscribers.

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Two start-up companies are betting that new satellite-delivered audio services launching over the next two years will do for radio what cable did for television: provide an incentive for programmers to develop new content and create an all-new revenue stream from subscription services.

XM Satellite Radio Inc. made news earlier this month when it announced that it received \$250 million in new financing from four backers: DirectTV Inc., General Motors Corp., Clear Channel Communications Inc. and a private-investment group including Columbia Capital, Telcom Ventures L.L.C. and Madison Dearborn Partners.

The company needs another \$670 million to launch its two satellites, as well as its consumer service, within the next two years, according to CEO Hugh Panero.

CD Radio Inc., XM's publicly traded competitor, has already raised \$1 billion through a combination of debt and equity, chairman David Margolese said.

In addition to financing, XM gains significant distribution assistance from its partnerships with GM and DirectTV. GM will factory-install new radios combining the AM, FM and XM bandwidths into its new cars, and its dealers will be able to demonstrate the new technology when customers come in to test-drive the vehicles. The vehicles will also be equipped with cigar-sized satellite antennas.

Panero said GM's backing is a huge vote of confidence for the new technology. CD Radio is also in serious discussions with car manufacturers.

DirectTV will pitch XM's aftermarket car radios, as well as home-audio equipment, to its current consumer-electronics retail accounts. The direct-broadcast satellite provider will also lend operational assistance to XM in matters such as conditional access, billing and customer service.

The new technology will bring to radio "the same convenience, choice and quality that cable and DirectTV have brought to television," Panero said.

Multichannel-audio service is not entirely new: Companies like DMX and Music Choice provide commercial-free music to cable and DBS subscribers in their homes and businesses, most often as add-ons to video subscriptions.

But XM and CD Radio are expected to have a more direct appeal because they plan to target captive audiences where they're most likely to listen to content, rather than view it.

Subscription radio is expected to appeal to car owners, truck drivers and recreational-vehicle enthusiasts who spend a great deal of time on the road.

Because XM and CD Radio are national services, drivers can travel between different markets without worrying about losing a signal in the middle of a song or talk show.

In larger, urban markets, terrestrial repeater networks -- much like

those used for wireless telephones -- will help to protect against interference from tall buildings.

The potential financial upside for the new companies is greater than that for cable television or DBS, executives and analysts predicted.

Bruce Leichtman, analyst for Boston-based market-research firm The Yankee Group, said there are several reasons why the market is poised to do well.

When asked about their interest in such a service, consumers readily understood the product proposition and grasped what the benefits would be, Leichtman said, which isn't always true with new technologies.

At \$10 per month, the service carries a reasonable price point, he added. And it will be ubiquitously deployed from day one, so customers won't be forced to wait for the service as they might for cable-modem availability, for example.

Leichtman predicted that up to 20 percent of the country's 200 million vehicle owners would sign up for satellite-radio subscriptions within the first five years of the service launches.

And in the event that those projections fall short, the new satellite-radio companies are poised to make a profit, even with more modest market penetration.

Margolese said CD Radio would reach breakeven on a cash-flow basis with less than 1 percent penetration. But he clearly expects the service to appeal to a larger audience.

Although skeptics might question whether consumers are willing to pay for yet another monthly subscription service, Margolese remains confident.

As in the early days of cable television, some asked why consumers would pay for something that they're accustomed to getting free-of-charge.

"They're usually the same people sitting with a bottle of Evian in front of them while tap water is available three feet away," Margolese said. "People pay for things that they could get for free all of the time."

DBS ANALOGY

Margolese said he thinks that CD Radio's launch has a market potential sum to those of DBS providers DirecTV and EchoStar Communications Corp. "if they had launched back in 1970, when cable wasn't entrenched, and when the main competition was free, over-the-air television."

Through its \$50 million investment in XM last week, DirecTV will own about 10 percent of the company. DirecTV also gains access to a portion of XM's satellite capacity, which it will use to launch its own original audio programming as a complement to XM.

DirecTV has not yet started to develop the new audio content, senior vice president of new ventures Steve Cox said, although the DBS provider has created original programming for its video service, including pay-per-view concerts. "Music is a logical involvement for us," Cox added.

Over time, DirecTV may negotiate with XM to bring some of its programming over to its DBS platform. Cox predicted that DirecTV -- which already offers Music Choice audio channels to its DBS subscribers -- would bring only a subset of XM's channels to its customers.

Since DirecTV and XM appeal to similar consumer demographics, Cox added, the companies would develop cross-promotional opportunities, which may eventually include discounts for subscribers who sign up for both services.

Premium and even pay-per-listen options are also possibilities for both XM and CD Radio down the road, although both companies said they would launch their services with basic packages of about 100 channels for \$10 per month.

DirecTV and XM may look at bringing seasonal sports packages, such as the National Football League's "NFL Sunday Ticket," over to the audio format, but the sports leagues would have to be involved directly in deals of that nature.

XM and CD Radio have already struck content deals with brands

recognizable to cable and DBS subscribers: C-SPAN, Black Entertainment Television, Cable News Network and Speedvision, for example.

"One of the significant things about providing content that works well in a mobile environment is that you get a terrific brand extension in the car," Panero said.

In most cases, the cable-programming companies will produce unique content for the audio platform, Margolese said. The exception would be talking-heads-type programming like that of C-SPAN, which translates well to radio.

CD Radio plans to offer 50 channels of commercial-free music, while another 50 channels of talk and information programming would be ad-supported.

As in the early days of cable, commercial-free programming will be one draw for the satellite-radio services. Other benefits similar to cable, Margolese said, would be the ability to get programming that you can't get on the radio today and the ability to get a clear signal where you otherwise could not.

A NATIONAL PLATFORM

Eventually, XM and CD Radio consumer hardware will be interoperable, as mandated by the Federal Communications Commission, Margolese said.

"What we're creating is a national radio platform, which does not exist today" Panero said.

"The business feels very similar to cable," he added. "That's one of the reasons why I feel very comfortable in it. It has a lot of the same excitement that existed in the early stages of cable and the early stages of DBS."

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